

NEW PROJECTS AND STUDIES

A NEW RENEWABLE SOURCE OF ENERGY USING THE SULFIDES IN THE DEEP BLACK SEA WATERS

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Abstract

There is one for now non-developed renewable energy source (RES). It is the energy of hydrogen sulfide dissolved in the deep waters of the Black Sea. Bulgaria could obtain additionally energy potential equivalent to 50 TWh due to the annual increase of hydrogen sulfide content. This amount is comparable to the annual energy consumption of Bulgaria. The technology may be of benefit not only Bulgaria and the Black Sea countries but for the entire Balkan Peninsula (currently heavily relying on lignite coal) and the EU.

Keywords: *renewable energy source, National recovery and resilience plan, climate change.*

JUSTIFICATION

There is one for now non-developed renewable energy source (RES). It is the energy of hydrogen sulfide dissolved in the deep waters of the Black Sea. Bulgaria could obtain additionally energy potential equivalent to 50 TWh due to the annual increase of hydrogen sulfide content. This amount is comparable to the annual energy consumption of Bulgaria.

The Institute of Chemical Engineering at BAS and the Recon Research Center SA have worked for the last fifteen years on the research and laboratory experiments on this subject. There are developed and tested laboratory samples of the main units of the technology. The obtained results show unambiguously the environmental, technical and economic feasibility of the introduction of the so-called "Sulfide Electric Power Plant" (SEPP) into the electricity

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distribution system. The intellectual property is protected by two patents and one useful model. The environmental benefit is enormous because the proposed technology contributes to the cleaning of the Black Sea of hydrogen sulfide.

DESCRIPTION OF THE PROJECT

The Black Sea basin differs from the other seas by the presence of dissolved hydrogen sulfide and sulfide (H_2S , HS^- и S^{2-}) in considerable concentration at depths below 150 meters. It is product the activity of thiobacteria reducing the sulfates (SO_4), being natural component of the sea water. The energy producing equipment oxidizes back sulfide to sulfate. Hence, in the considered case sulfide are renewable energy source (RES). The annual increase of hydrogen sulfide is 20 mln tons and its processing could produce up to 100 TWh electrical energy. It corresponds to a continuously operating facility of 12 000 MW.

The sulfide potential of the Black Sea is about 5 bln tons, equivalent to 25000 TWh electricity. Hence, if new RES with power of 40 000MW will be introduced, the produced green energy will consist 10% of the annually used electricity in EU and the Black Sea will be cleaned for sulfide to a considerable depth.

SEPS operates on floating rigs, anchored beyond the continental shelf at 10 to 90 km from the coastline, depending on the bottom relief. The rigs are equipped by inlet pipes to supply water to the surface from the 1000 meters depth. Hence, the dissolved sulfide are extracted from the supplied water and electric energy is produced. The processed water is discharged to depths of 300 meters by outlet pipes.

The system is closed, it operates under oxygen-free conditions and does not admit the propagation of anaerobic pathogens. Sulfide sufficient for the yield of 1 kWh electricity are extracted from 16 cubic meters seawater.

The electricity is transferred to the shore in high-tension mode by underwater cables.

ADVANTAGES AND EFFECTS OF THE SEPP APPLICATION

1. For the Black Sea region, SEPP is a Base load power plant with continuous operation during the entire period of operation. Because it is made up of more than a hundred individual modules, annual shutdowns for technological repairs are avoided, with the removal of one module reducing power by less than one percent.
2. During operation, expenses are constant and do not depend on the amount of electricity produced. This allows to maintain a constant economically justified price, which will stabilize the price levels in the market.
3. SEPP behaves as a battery for the electricity grid. It means, that it produces the amount of energy that is demanded in the moment, i.e. there is no over-production at missing users. The power station can operate continuously with regulated capacity from 0 to 100% output power.
4. The process does not generate any harmful emissions in air and water. The energy production is fully automated and does not demand personnel. The entire technological process is remotely controlled. SEPP does not represent any threat for the environment at possible accident.

5. The capital costs of SEPP are comparable to the ones for construction of nuclear power stations. They are between 5,000 and 6,000 Euros for installed power of 1 kW. This energy does not require subsidies for green energy and it could compete on the free non-regulated market.
6. Drastic decrease of the import of energy sources (oil, natural gas, nuclear fuel). Nowadays, 54% of the energy sources demand is covered by import to Bulgaria and EU. The running changes in the transport structure to increase the share of electricity this percentage will increase. The strategic objective to turn all of the electricity production to local resources becomes achievable by introducing SEPP. This fact will guarantee the energy security of the country in electricity.
7. Creating export potential for green energy. There are schemes in the EU enabling the member states to develop RES in a relatively cheaper way, to sell the surpluses to the states where this production is more expensive and thus to achieve the common target at the possible lowest expenses. These facts open the access to a considerably big market of RES.
8. These two facts will lead to conditions enabling almost elimination of Bulgaria's current account for the deficit, currently due more than 50% to imports of natural gas, crude oil and nuclear fuel from state owned or state controlled companies of the Russian Federation.
9. The production of floating rigs will open more than 15,000 new jobs for qualified workers at the labor market. It is a development of new production branch with considerable export capacity. Since the share of Bulgaria in the Black Sea region is below 7%, there will be a big market for SEPP in Turkey, Ukraine, Russia, Romania and Georgia.
10. The improvement of the environmental conditions in the Black Sea is a grandiose task by itself. The back gaining of hydrogen sulfide free zone of 150 meters only the aerobic space in the sea will be increased twice. This fact will enhance the development of biosphere with fishery and aquacultures.
11. Ensuring the economy and customers by cheap energy. The price of energy determines to high extent the potential of economy development. The transition to non-regulated market of affordable energy prices will have a social effect on the population. The expected price of SEPP energy is 75 Euros/MWh for the year 2025, being lower than the average price of electricity produced by RES according to the EU forecasts.

NECESSARY ACTIONS

It is necessary to finalize the SEPP technology financing the following activities:

1. Pilot project for construction of fuel cell of 100 kW power.
2. Pilot project of enrichment unit with a coefficient **1:20** for increasing sulfide concentration in sea water containing **10 g per cubic meter** sulfide.

THE TOTAL ESTIMATE OF THE TARGET FINANCING IS BETWEEN 14 AND 16 MLN EURO.